

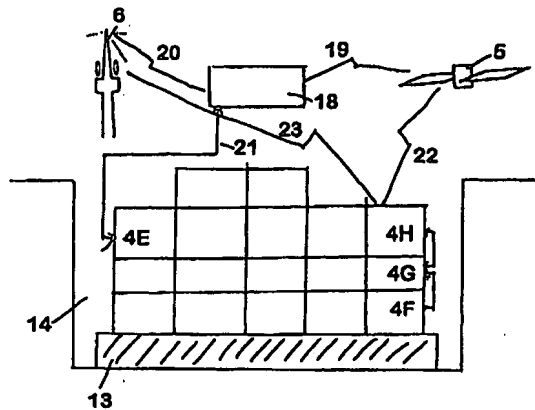
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: A METHOD OF LOCALIZING STORAGE DEVICES, A MONITORING SYSTEM FOR LOCALIZING STORAGE DEVICES FOR GOODS, AND USE OF THE MONITORING EQUIPMENT



## (57) Abstract

The present invention relates to a method and a monitoring system, in particular for use in the monitoring of containers (4). Each container has a radio connection to positioning satellites of the GPS type (5), the SatCom type (6) as well as near field communications equipment from which data may be transferred to a data processing unit. Thus, according to the invention several possible radio connections are provided between the individual near field communications equipment, it being first checked whether a connection can be established to the position satellite, and if this is not possible, it is attempted to establish a radio connection to the communications satellite. If this cannot be done either, then a radio connection is established to another near field communications equipment. The containers can hereby be monitored and tracked currently if for some reason they loose a radio connection. If the containers are placed at particularly difficult places, an embodiment of the invention comprises near field communications equipment which is not placed on any container and which can communicate with the containers and with the satellites.

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A method of localizing storage devices, a monitoring system for localizing storage devices for goods, and use of the monitoring equipment

5 The invention relates to a method of localizing storage devices, e.g. containers, where each container is equipped with a data processing unit programmed to try to position the unit concerned at determined intervals by establishing a connection to a positioning satellite, and  
10 where each container is moreover equipped such that a message on observed positions may be emitted via a communications satellite.

The invention moreover relates to a monitoring system for  
15 localizing storage devices for goods, e.g. containers, where each container is also equipped with a near field radio system which enables communication between the data processing units in the individual containers and between the containers and near field radio systems on yards,  
20 ships, trains or other transporting or storing units.

Finally, the invention relates to uses of the method and the monitoring system.

25 US Patent No. 5 565 858 discloses a localization system for use in connection with the monitoring of containers comprising a group of containers which are e.g. stored. Each container has communications equipment which consists of a satellite communications device and a near  
30 field communications device. The satellite and near field communications devices are capable of communicating with each other so that an arbitrary container can communicate its position directly via other containers to a GPS positioning system, or indirectly via a connection to an in-  
35 terrogator.

Another monitoring system is known from the applicant's own International Patent Application WO 96/16387.

5 This known monitoring system, which is used e.g. in connection with the monitoring of containers, in principle consists of a communications system in which exchange of information with the surrounding world takes place via communications satellites, e.g. of the GPS type. Each container has a radio connection to a data processor system. Each container additionally has a data connection to  
10 a tag, which cooperates with the radio connection of the container in such a manner that if the data connection of the container is removed from the container, a connection to a satellite will be established via the data processor  
15 system.

The system operates fully satisfactorily as long as there is a good connection between the satellite and the data processor system. However, the data processor system requires that there is a line of sight between the data  
20 processor system and the satellite. This cannot always be satisfied, e.g. if containers and the data processor system connected to it are stored on the bottom of a ship or on a train which drives through a tunnel. Furthermore, it  
25 is a drawback that if a radio connection fails, it may be difficult to find the reason for the failure.

Accordingly, an object of the invention is to provide a system which, in an even faster manner, is capable of  
30 monitoring storage devices for goods, e.g. containers, and of providing an indication of what is wrong if a container cannot be positioned.

The object of the invention is achieved by a monitoring  
35 system of the type defined in the introductory portion of claim 1 which is characterized in that the data process-

ing unit in each container will individually try to determine its position and communicate information on this via a communications satellite, and which, when no connection to the positioning satellite can be established, is adapted to transfer data to a communications satellite containing the information that a connection to the positioning satellite cannot be established.

When contact to the communications satellite cannot be established, the data processing unit, as stated in claim 2, activates the near field radio system and tries to connect to another near field radio which is capable of creating or has contact to the positioning and communications satellite via a data processing unit or in another manner. It is ensured hereby that all containers positioned within the overall operating range of the near field radio system can position and communicate their positions to the surrounding world.

The individual containers can hereby transfer data between each other and to the surroundings via the radio connections, thereby achieving a greater certainty that the desired positioning of the individual container can be established, and information on this can be applied and enable tracking of any containers with faulty equipment for the satellite-based positioning and communication.

It is moreover expedient, as stated in claim 3, that precisely as many radio connections are established between near field communications equipment on a plurality of storage devices as are sufficient to set up radio connection to the positioning satellite and the communications satellite, respectively.

35

As mentioned, the invention also relates to a monitoring system.

This monitoring system is characterized in that each  
5 storage unit, container, is provided with equipment  
which, in combination, enables positioning and tracking  
of the individual unit, also when it is not possible to  
create contact to the satellites concerned for position-  
ing and communication because of functional restraints or  
10 because parts of the equipment are out of order.

As stated in claim 5, each container is equipped with a  
data processing unit which is programmed to initiate a  
procedure for producing ID as well as for determining  
15 the position and time of it and for presenting this in-  
formation via communication with satellite or near field  
radio system.

In order to be able to identify the individual containers  
20 additionally, it is expedient, as stated in claim 6, that  
the container which establishes a connection to one or  
more other containers is adapted to produce its own iden-  
tification data.

25 In order to additionally ensure careful monitoring of the  
containers, it is an advantage, as stated in claim 7,  
that each container tries to set up a connection to the  
positioning satellite at suitable intervals.

30 For use of the monitoring equipment according to the in-  
vention in connection with locations where no container  
can establish a connection to a satellite, it is an ad-  
vantage, as stated in claim 8, that the near field commu-  
nications equipment of the containers is in communication  
35 with further near field communications equipment which is  
not positioned on the containers.

As mentioned, the invention also relates to uses of the monitoring system according to the invention.

5 These uses are defined in claims 10 - 12.

The invention will now be explained more fully with reference to an example shown in the drawing, in which

10 fig. 1 shows examples of the storage of containers under various conditions,

fig. 2 shows a basic sketch of the mode of operation of the monitoring system according to the invention, and

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fig. 3 shows a further embodiment of the mode of operation of the system according to the invention.

In fig. 1, 5 designates a GPS positioning satellite for providing position data, while 6 designates a SatCom communications satellite for providing communications data. As will be seen in the figure, the satellites 5, 6 can establish data transfer to a truck 1, a containership 2 with several containers 4, or a train 3 with carriages 12. Each container has an antenna capable of reading information from a tag which is positioned on an underlying container, e.g. as shown on the ship 2, at the reference numeral 10. This system is described in detail in the previously mentioned WO application. In brief, the mode of operation of the system is such that if one of the containers is unlawfully removed, then a radio connection between the bridge of the ship and the container will ensure that a connection is set up to e.g. a police authority. Fig. 1 moreover shows a train with a plurality of carriages 12, each of which communicates with a locomotive, which in turn communicates with the satellites 5,

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6. Finally, fig. 1 shows a plurality of containers which are stored at a site where they are in radio connection with a stationary data connection unit 9 which communicates with the satellites 5, 6.

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In fig. 2, 5 and 6 again designate the GPS positioning satellite and the SatCom communications satellite, respectively. The figure also shows a plurality of containers 4 which are placed in a space schematically shown at 10 14, which might e.g. be on board a ship. It is moreover shown schematically that the satellites 5, 6 are in radio connection with the containers which are designated by 4C and 4I. All the containers are moreover equipped with a positioning satellite system, a communications satellite 15 system, and near field communications equipment, which, however, are not shown in detail in the figure. The near field communications system is capable of establishing a connection between the individual containers. As a result of this, if e.g. the container 4A is to be able to communicate with the satellites 5, 6, then near field communication will be established from the container 4A via 4B to 4C, which communicates with the satellites 5, 6. The position of the container 4A may hereby be determined reasonably accurately. To make the system even more 25 flexible, it is possible to set up relay stations 16 so that e.g. a connection from the container 4D may be established via the radio connections 17 and the relay station 16, further via the radio connection 17A and the container 4I, which, as mentioned, communicates with the 30 satellites 5, 6. The same connection might be set up between the containers 4D and 4I, as shown.

It is noted that each container, if there is a line of sight, has the possibility of communicating directly with 35 the positioning satellite as well as the communications satellite.



Fig. 3 shows a variant of the embodiment of fig. 2, a near field communications device 18 being established here, which is not positioned on a container, but has a good connection to the satellites 5, 6. Such a set-up may be useful if e.g. the containers are placed so deep down in a ship that is impossible for any satellite communications equipment of any of the containers to establish a connection. Of course, more near field communications devices of the type 18 than shown in the drawing may be set up.

As will be appreciated, the invention provides a system which is capable of monitoring any container in a very safe manner no matter where in the world it is located.

The principles of the invention have been explained particularly in connection with containers, but basically they may be used in connection with all movable objects where security against theft and vandalism is desired.

## P a t e n t   C l a i m s :

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1. A method of localizing storage devices, e.g. containers (4), where each container is a container which is equipped with a data processing unit programmed to try to position the unit concerned at determined intervals by establishing a connection to a positioning satellite, and where each container is moreover equipped such that a message on observed positions may be emitted via a communications satellite, c h a r a c t e r i z e d in that the data processing unit in each container will individually try to determine its position and communicate information on this via a communications satellite, and which, when connection to the positioning satellite cannot be established, is adapted to transfer data to a communications satellite containing the information that a connection to the positioning satellite cannot be established.
2. A method according to claim 2, c h a r a c t e r i z e d in that when contact to the communications satellite cannot be established, the data processing unit activates the near field radio system and tries to connect to another near field radio which is capable of creating or has contact to the positioning and communications satellite via a data processing unit or in another manner.
3. A method according to claim 2, c h a r a c t e r i z e d in that precisely as many radio connections between near field communications devices on a plurality of storage devices are established as are necessary to set up a radio connection to the positioning satellite and the communications satellite, respectively.

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4. A monitoring system for localizing storage devices for goods, e.g. containers (4), where each container is also equipped with a near field radio system which enables communication between the data processing units in the individual containers and between the containers and near field radio systems on yards, ships, trains or other transporting or storing units, characterized in that each storage unit is provided with equipment which, in combination, enables positioning and tracking of the individual unit, also when it is not possible to create contact to the satellites concerned for positioning and communication because of functional restraints or because parts of the equipment are out of order.
5. A monitoring system according to claim 4, characterized in that each container (4) is additionally equipped with a data processing unit which is programmed to initiate a procedure for producing ID as well as for determining the position and time of it and for presenting this information via communication with satellite or near field radio system.
6. A monitoring system according to claim 5, characterized in that the container which establishes a connection to one or more other containers is adapted to produce its own identification data.
7. A monitoring system according to any one of the preceding claims, characterized in that each container tries to set up a connection to the positioning satellite at suitable intervals.
8. A monitoring system according to any one of the preceding claims, characterized in that the near field communications equipment of the containers is

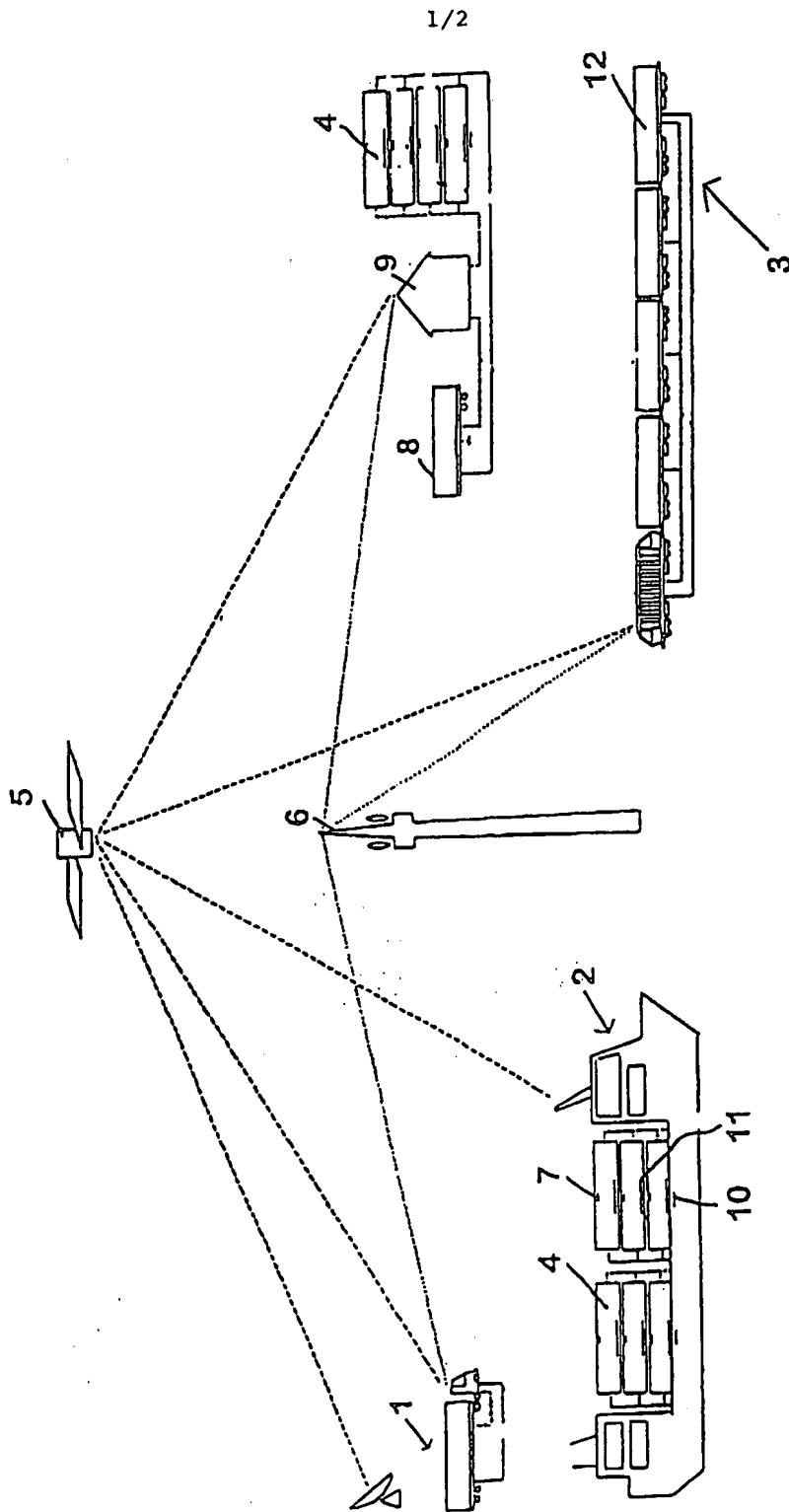
in communication with further near field communications equipment (18) which is not positioned on the containers.

9. A monitoring system according to any one of the preceding claims, characterized in that the positioning satellite is formed by a GPS system (Global Positioning System) (5) and the communications satellite (Satellite Communications System) (6) is formed by a Sat-Com system, while the near field communications equipment is an SR (Short Range) system.

10. Use of the method and the storage device according to any one of claims 1-9 on a containership (21).

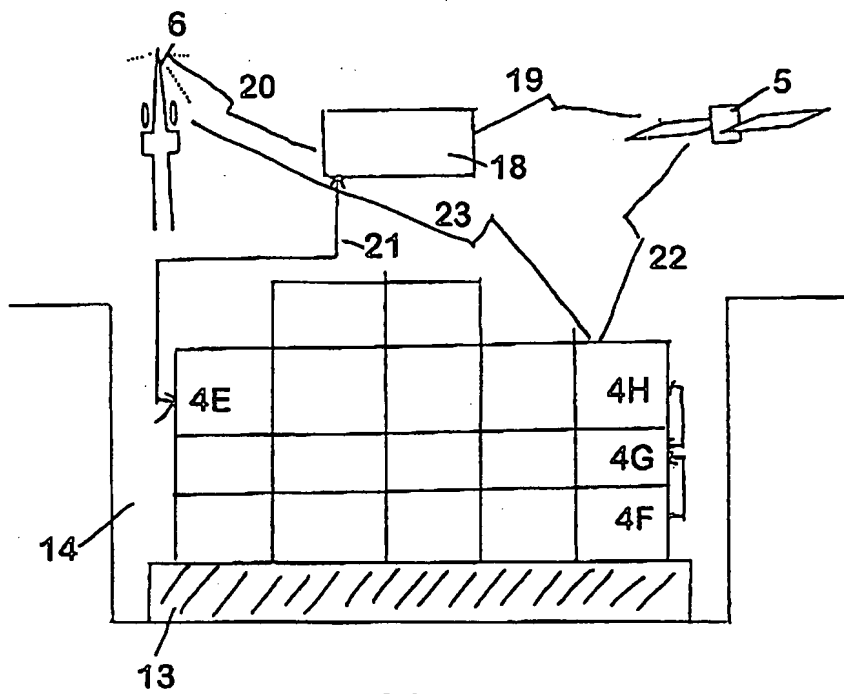
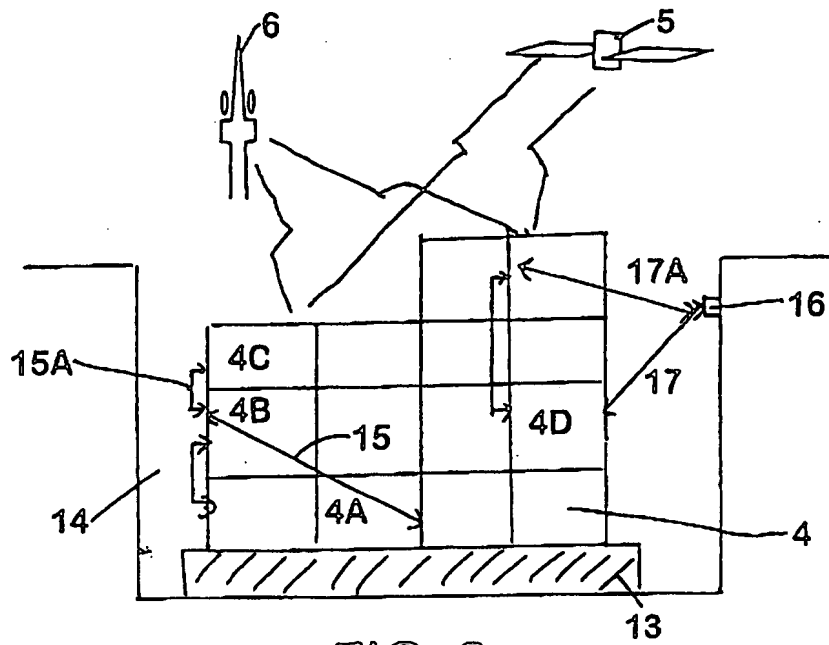
11. Use of the method and the monitoring system according to any one of claims 1-9 on a goods train (3).

12. Use of the method and the storage device according to any one of claims 1-9 on a storage site for containers.



SUBSTITUTE SHEET (RULE 26)

2/2



# INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 98/00144

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
IPC6: G08G 1/127, G01S 5/14, B61L 25/02 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
IPC6: B61L, G01S, G08G		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE,DK,FI,NO classes as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
WPI		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5565858 A (WARREN E. GUTHRIE), 15 October 1996 (15.10.96), column 3, line 62 - column 7, line 52; column 11, line 1 - column 12, line 63, figures 3a, 3b, 6, abstract	4-8,10-12
A	--	1-3,9
X	EP 0748084 A1 (GENERAL ELECTRIC COMPANY), 11 December 1996 (11.12.96), page 3, line 41 - page 5, line 7, abstract	4-12
A	--	1-3
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
4 Sept 1998		10-09-1998
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Form PCT/ISA/210 (second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 98/00144

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9616387 A1 (PEDERSEN, HEINE, E.), 30 May 1996 (30.05.96), page 8, line 30 - page 10, line 4, figure 3, abstract  --	1-12
A	US 5517199 A (JOHN J. DIMATTEI), 14 May 1996 (14.05.96), abstract  -- -----	1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 98/00144

**Box I** Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II** Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see next page

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1992)

I. Claims 1-3, and claims 10-12 when referring to claims 1-3, relate to a method of localizing storage devices by means of a positioning satellite and transmitting the position via a communication satellite.

II. Claims 4-9, and claims 10-12 when referring to claims 4-9, relate to a system for localizing storage devices by means of near field radio equipment.

These groups of inventions are not so linked as to form a single general inventive concept (PCT Rule 13.1). There is no technical relationship among those inventions involving one or more of the same or corresponding "special technical features" within the meaning of PCT Rule 13.2 (the contribution which the invention, considered as a whole, makes over the prior art).

The special technical features of group I relate to transmitting information that a connection to the positioning satellite cannot be established, while the special technical features of group II relate to near field radio communication between individual containers or between a container and another storing unit. The word "also" in claim 4 is not considered to make the claim include satellite communication as the claim lacks reference to previous claims.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

27/07/98

International application No.

PCT/DK 98/00144

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5565858 A	15/10/96	GB 2307370 A,B GB 9704879 D JP 10506357 T WO 9608760 A	21/05/97 00/00/00 23/06/98 21/03/96
EP 0748084 A1	11/12/96	CA 2176882 A IL 118286 D JP 9133757 A US 5588005 A	08/12/96 00/00/00 20/05/97 24/12/96
WO 9616387 A1	30/05/96	AU 692327 B AU 3978195 A BG 101560 A CN 1170470 A CZ 9701552 A EP 0793838 A FI 972166 A NO 972308 A PL 320334 A SK 63497 A	04/06/98 17/06/96 30/12/97 14/01/98 15/10/97 10/09/97 21/07/97 09/07/97 29/09/97 05/11/97
US 5517199 A	14/05/96	NONE	

Form PCT/ISA/210 (patent family annex) (July 1992)